Conservation Solutions for Wildlife Recovery

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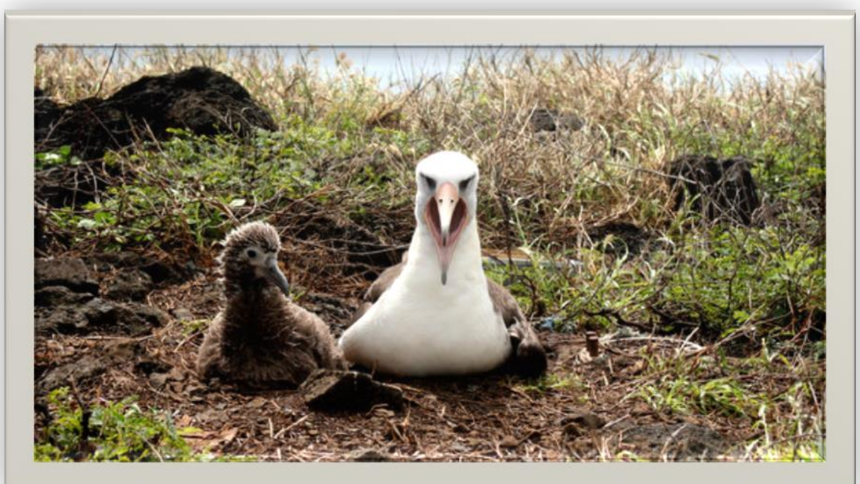
Hypothesis, data, & statistics-driven management decisions

- Value judgments vs technical judgments
- Technical judgment
  - Well-written, well-defined criteria for success
  - Verifiable outcome
  - Population management advances only when the efficacy of a management treatment is tested



Management Process

- Identify policy
- Identify stakeholders
- Identify the problem
- Clearly state objectives
- What are our options?
- What do we need to know?
- What research is needed?
- Decision matrix

Identify the Problem: Why do populations go extinct?

- Stochastic extinctions
  1. Demographic malfunction (small populations)
  2. Genetic malfunction (loss of heterozygosity)
- Driven extinctions

3 most common causes of driven extinctions:

1. Contraction & modification of habitat
2. Unsustainable harvesting by humans
3. Introduction of a novel pathogen, predator, or competitor into the environment

Contraction & Modification of Habitat

- Generalists vs. Specialists
- Habitat: food, protective cover from predators, denning sites, shelter from inclement weather, access to mates
- Patchiness of habitat
- Extinction: negative function of patch size
- Colonization rates: low when patches are widely spaced
- Data: local extinction and recolonization events across a matrix of possible sites

Habitat Fragmentation

- Edges:
  - some species require interior forest habitats
  - More edge = more incursion of predators from outside the patch, increasing predators on interior forest species
- Connectivity:
  - some species need to disperse through intact habitat

Unsustainable harvesting by humans

- Game species:
- Sustainable: species with high fecundity, rapid turnover, broad geographical distribution, ability to tolerate interference by hunting humans
- Unsustainable: Hunting for male ornaments (horn, tusks, antlers, etc.)
  - Black rhinos, elephants, big cats
- Value increases with age of male
- Ex: lions
  - Simple harvesting strategy, reliable clue to age

Co-evolution

- Long-term evolutionary adjustments among species
- Predator-prey
- Parasite-host
- Flowers & pollinators

Consumer-Resource Dynamics

- Study of interspecific interactions to provide a mechanism for the ways in which individuals interact with one another (MacArthur and Levins 1967)
- Energy and/or nutrient transfer between an organism (consumer) and a resource
- Resource: any biotic or abiotic factor that increases the population growth of its consumer

Consumer-Resource Dynamics

- Consumers change/deplete the availability or abundance of the exploited resource
  - predation, competition, grazing, mutualism, parasitism, and more (quite broad)
- Quantity and quality of resource
- Consumer-resource interactions occur across trophic levels
- To understand a system you must simulate/model complex interactions

Introduction of a novel species

- Modification of trophic relationships
- Ex: Endemic species on islands

1. Predator-prey theory
   A. Introduction of an efficient predator
      - High rates of capture even at low prey densities
      - High efficiency of conversion of prey into offspring
      - Results in small prey population → stochastic demographic/environment dynamics increase probability of extinction
      - Ex: brown tree snake

Introduction of a novel species, cont.

B. Introduction of prey species leading to hyperpredation

- Exotic prey with higher reproduction subsidizes native predator, increasing predation on native prey
- Asymmetric apparent competition induced via subsidies to a common predator population
- May lead to:
  - Extinction of endemic prey but perpetuation of exotics and predators
  - Extinction of exotics but perpetuation of endemic prey and predators
  - Extinction of predators but perpetuation of both prey
  - Coexistence of all three species
  - Ex: Channel Island fox, feral pig, golden eagles

Introduction of a novel species

C. Reduction of prey – Effects on native predators

- Loss of prey results in reduction in native predators
- Ex: tigers, leopards, ungulates

Other causes of decline

- Side effects of pest control
  - Ex: black-footed ferret
- Poorly regulated commercial hunting
  - Ex: commercial whaling
- Unregulated recreational hunting
  - Ex: Arabian oryx
- Competition with introduced species
- Environmental contaminants
  - Ex: raptors
- Introduced diseases
  - Ex: Hawaiian birds

How to prevent extinction

- Identify the problem
- Is the cause of decline a single factor or a combination of factors?
- Are those factors still operating?
- If so, can they be nullified?

Management Objectives

- Increase population
- Decrease population
- Harvest population for continuing yield
- Leave it alone but keep an eye on it

What can managers control? (our options…)

- Remove invasive predators or other forms of “take”
- Remove invasive plant species
- “improve” habitat (somewhat) – species specific

How to prevent extinction

- Hypothesis-driven testing & development of “best practices”
- Rescue and recovery
  - Fencing
  - *Ex situ* (zoos, captive breeding programs)
  - Translocation
  - Genetic rescue
  - Food, nutrition & diet considerations
  - Restoration of coevolved, interdependent relationships
- Places of conservation

Ex situ management

- Preserve and amplify a population of an endangered species outside its natural habitat
- Goal of reintroduction to natural habitat
  - 12 individuals minimum
  - 20 considered safe
  - Test release: use tracking devices
  - May use closely related species as a probe

Places of Conservation Historical Objectives

- Land-area relationships
- The most important objective is to conserve scenery and “nice” animals (restrict roads, exterminate carnivores; ex: Banff National Park)
- The most important objective is the conservation of soil and plants (hunt to reduce pressure of grazing and browsing)
- The most important objective is the conservation of the physical and biological state of the park at some arbitrary date (arrival of first Europeans)

Historical Objectives, cont.

- Conserve representative examples of plant and animal associations
- The most important objective is the conservation of “biological diversity” (the more species, the better)
- The most important objective is the conservation of “genetic variability” (the more species, the better)
- The purpose of a nature reserve is to maintain, hopefully in perpetuity, a highly complex set of ecological, genetic, behavioral, evolutionary and physical processes and the coevolved, compatible populations which participate in these processes.

Conservation Outside National Parks

- Importance of legislation
  - Control killing of species
  - Controls over land clearing, protecting habitat
  - Environmental impact assessment
  - Laws governing conservation outside national reserves should take legal precedence over forestry and mining law

National parks & reserves

- Land use
- Species conservation is priority in national parks & reserves (~10% globally)
- Advantages:
  - Fragile habitat protection
  - Large species conservation (large herbivores, carnivores)
  - Ecological baselines or benchmarks

National parks & reserves

- Disadvantages
  - Do not represent all ecosystems or communities
  - Too small to maintain viable populations
  - May alienate locally indigenous peoples excluded by central governments

Community Conservation Areas

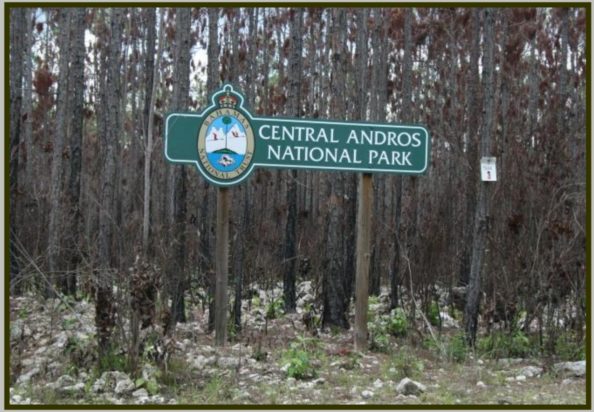
- Advantages:
  - represent species not included in protected areas
  - Co-opt support of local peoples if benefits accrue to them
- Disadvantages:
  - Tend to protect only species of direct benefit to humans and ignores the rest
  - Excludes species that are detrimental to humans
  - Tend to discount the future due to increasing human population demands on the ecosystem and accelerating economic expectations from the system even with stationary human populations, resulting in species loss and ecosystem decline

Case study: Bahama Oriole

- Current and projected problems
  - Habitat deterioration
  - Novel predator
  - Sea level rise
- Current efforts
  - ??
- Research tools
  - Surveys
  - Basic biology studies
  - GIS modeling

Case study: Bahama Oriole

- Habitat Management tools
  - Removal of Shiny Cowbirds
  - Habitat protection and restoration
  - Community education
  - Fire management policy
- Managing agencies
  - Bahamas National Trust
- Cost



Case study: Hawaiian tree snails

- Current and projected problems
  - Heavy predation
  - Habitat deterioration
  - Temperature, precipitation changes
- Current efforts
  - Removal of invasive plants, predators
- Research tools
  - GIS modeling
  - Conservation genetics

Case study:
Hawaiian tree snails

- Species Management tools
  - Exclosures
  - Genetic rescue
- Managing agencies
  - Oahu Army Natural Resources Program
  - US Fish and Wildlife
  - Hawai‘i Department of Land and Resources, Snail Extinction Prevention Program
- Cost
  - Managing species vs. managing habitat

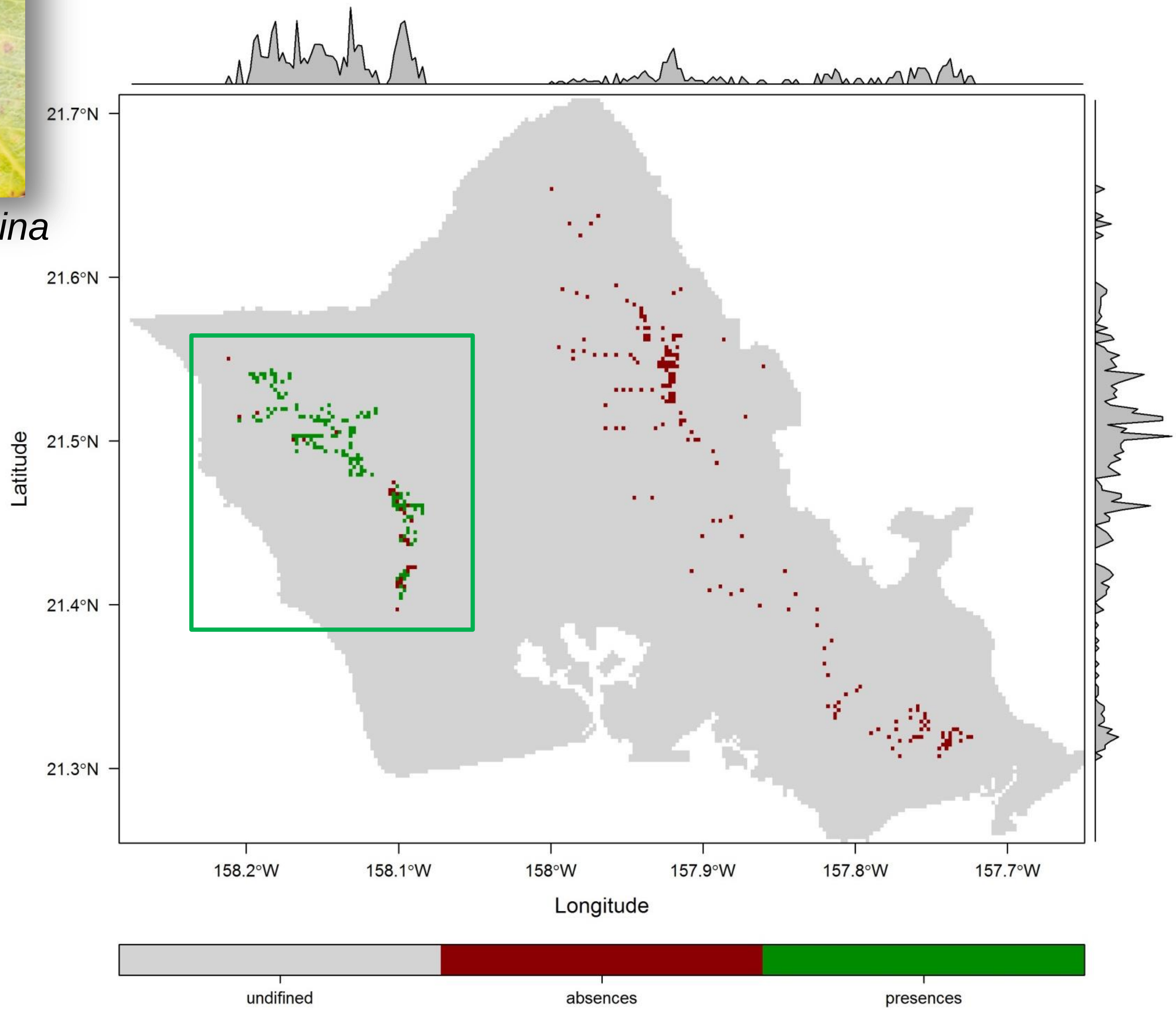
QUESTION 1:

Where will Hawaiian tree snails will be most likely to survive projected warmer and drier temperatures over the next century?

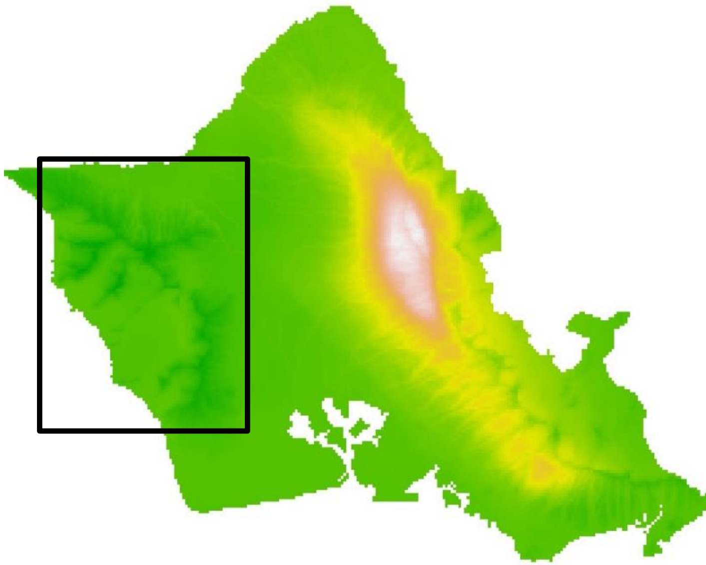
GIS Modeling Collaborator: Adam Vorsino, USFWS

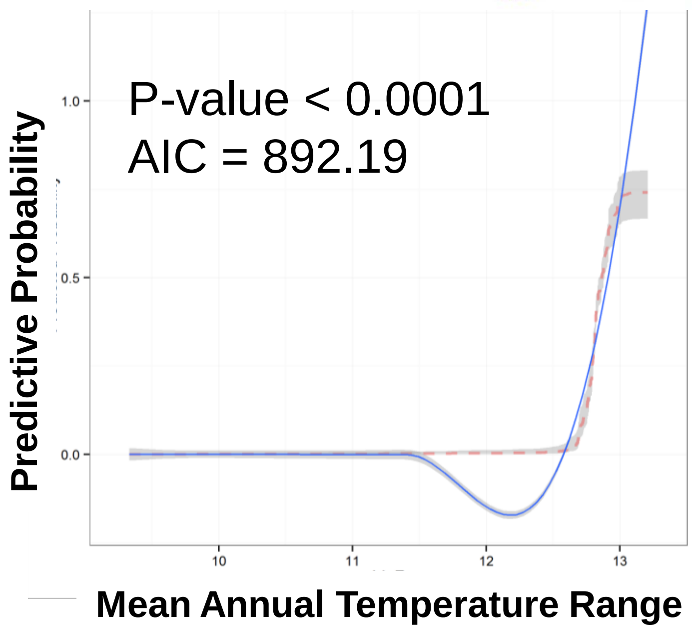
PRESENCE VS. ABSENCE POINTS

Achatinella mustelina

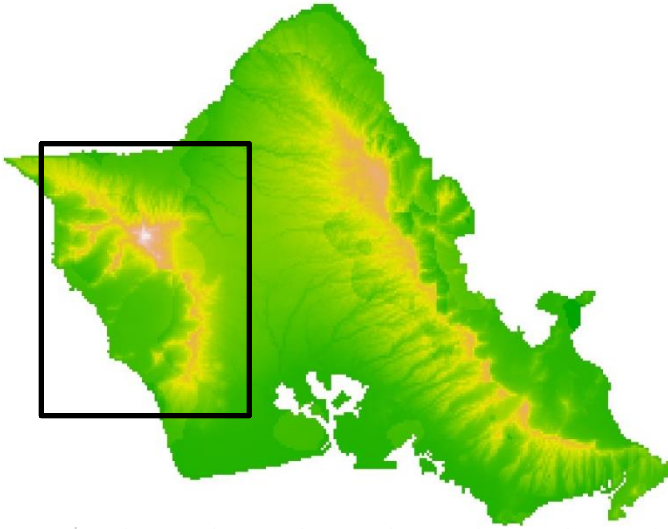


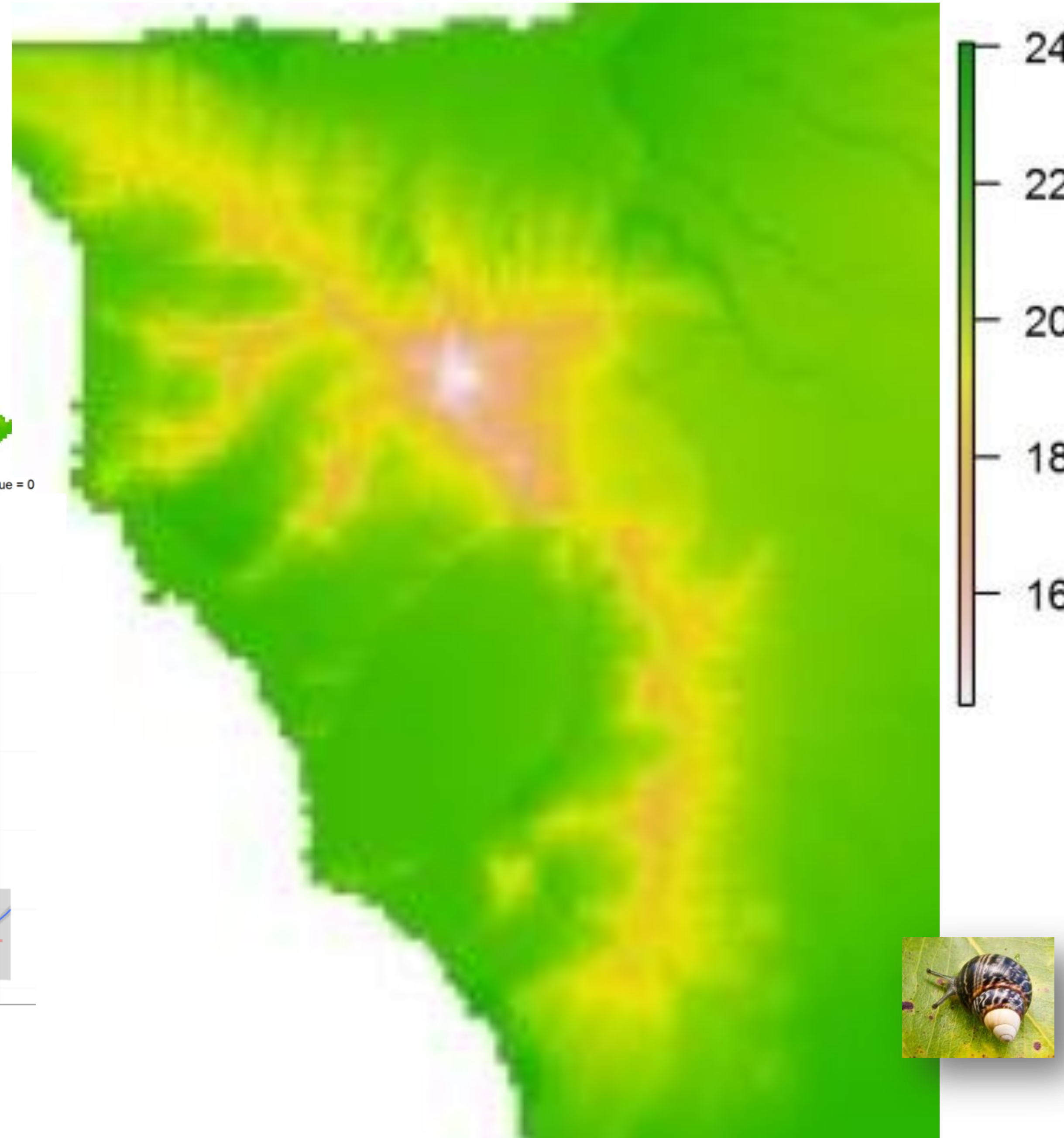
Mean Annual Temperature Range

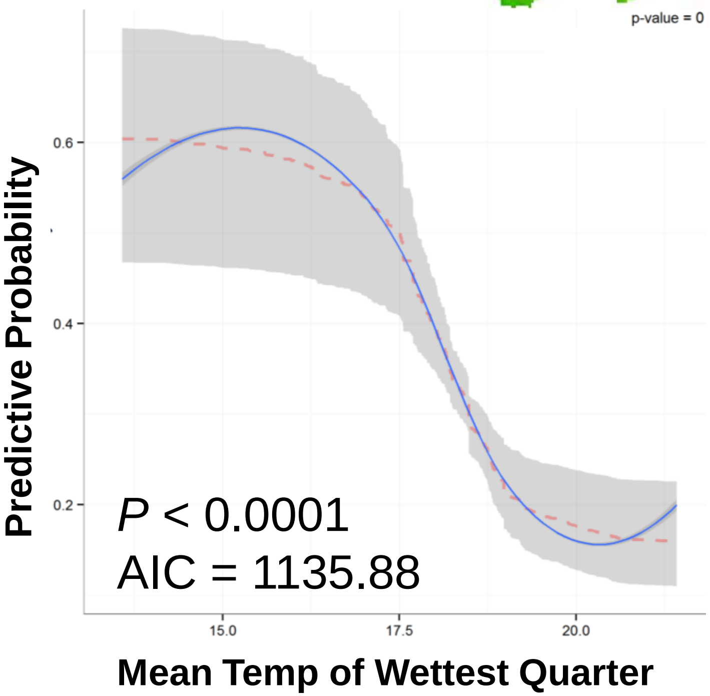




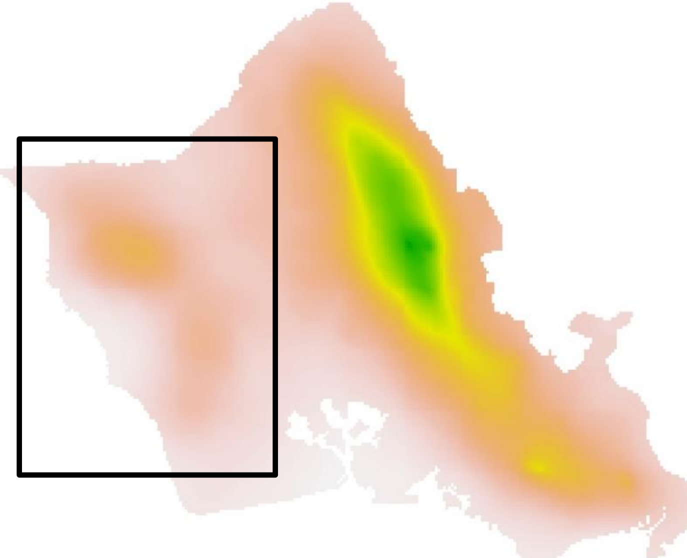
Mean Temperature of the Wettest Quarter (Season)

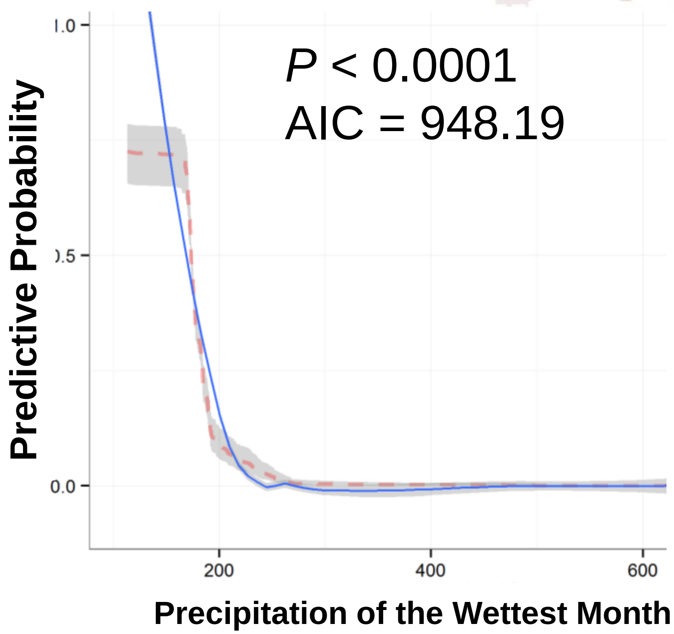


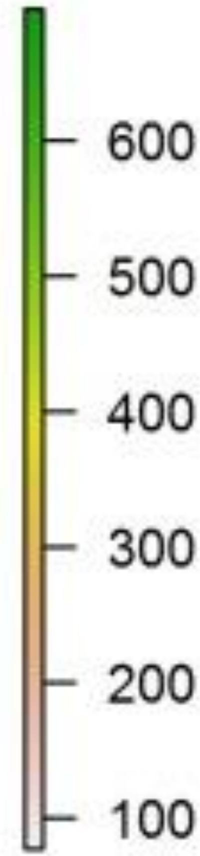




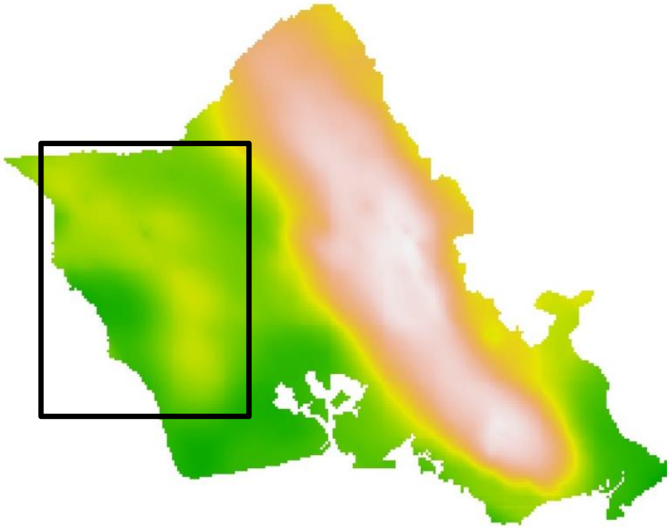
Precipitation of the Wettest Month

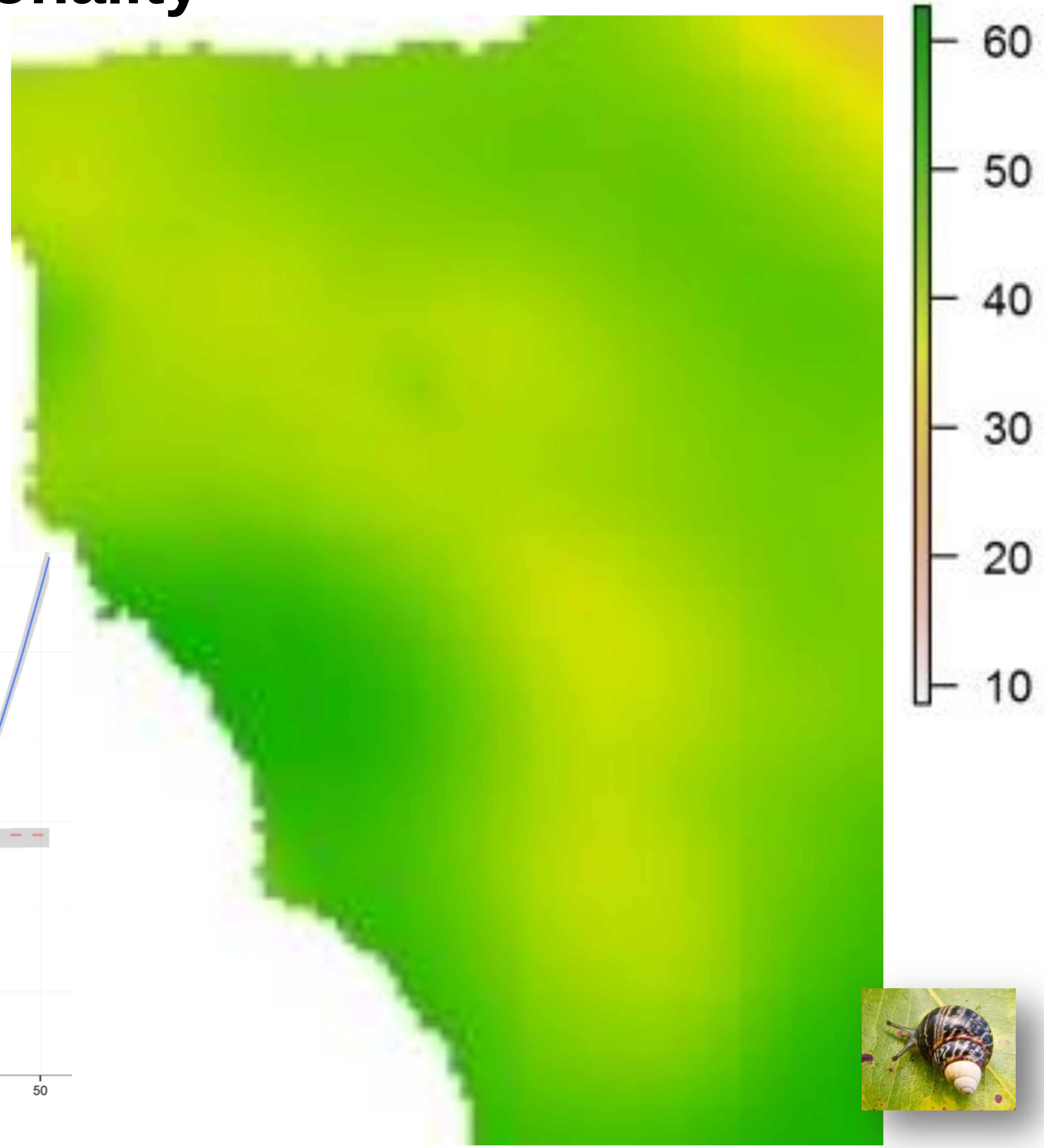


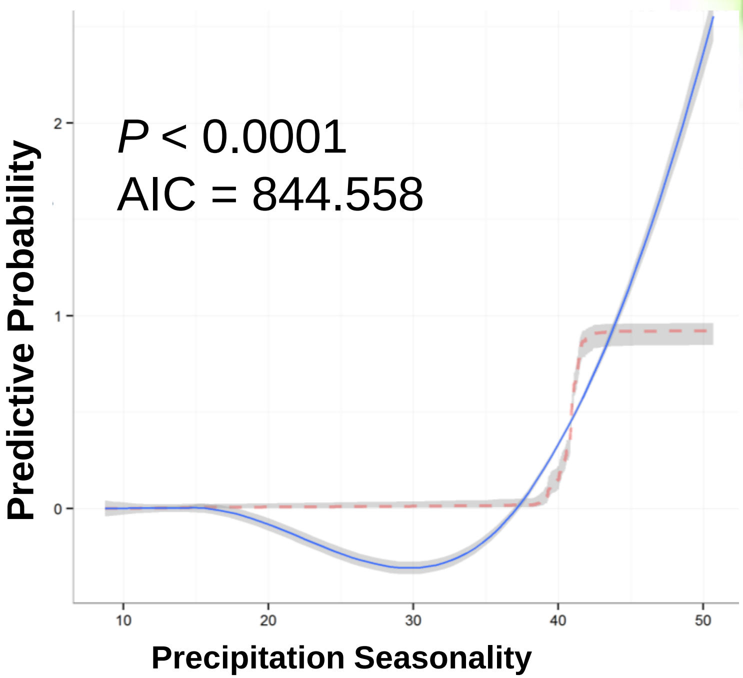




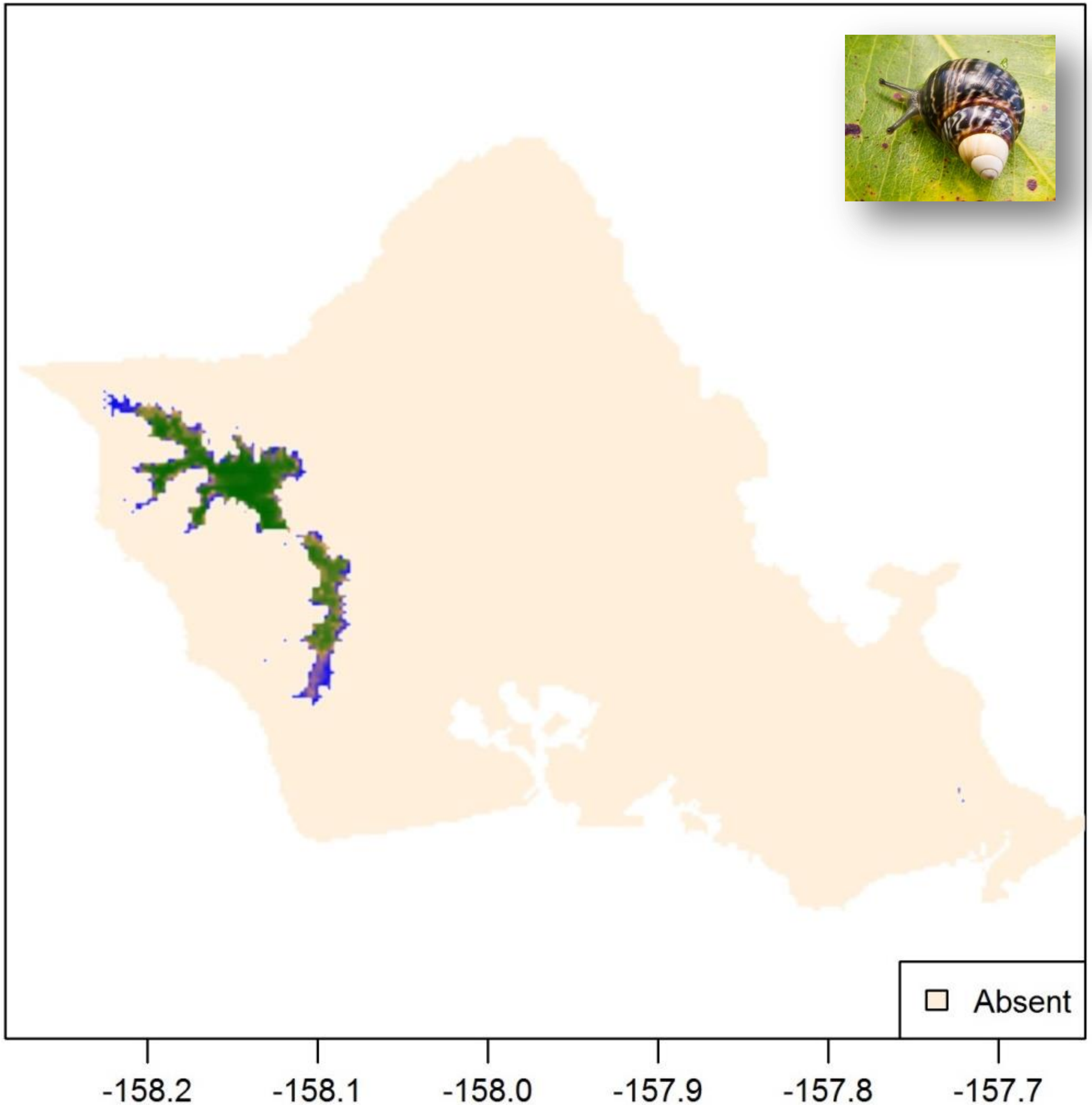
Precipitation Seasonality







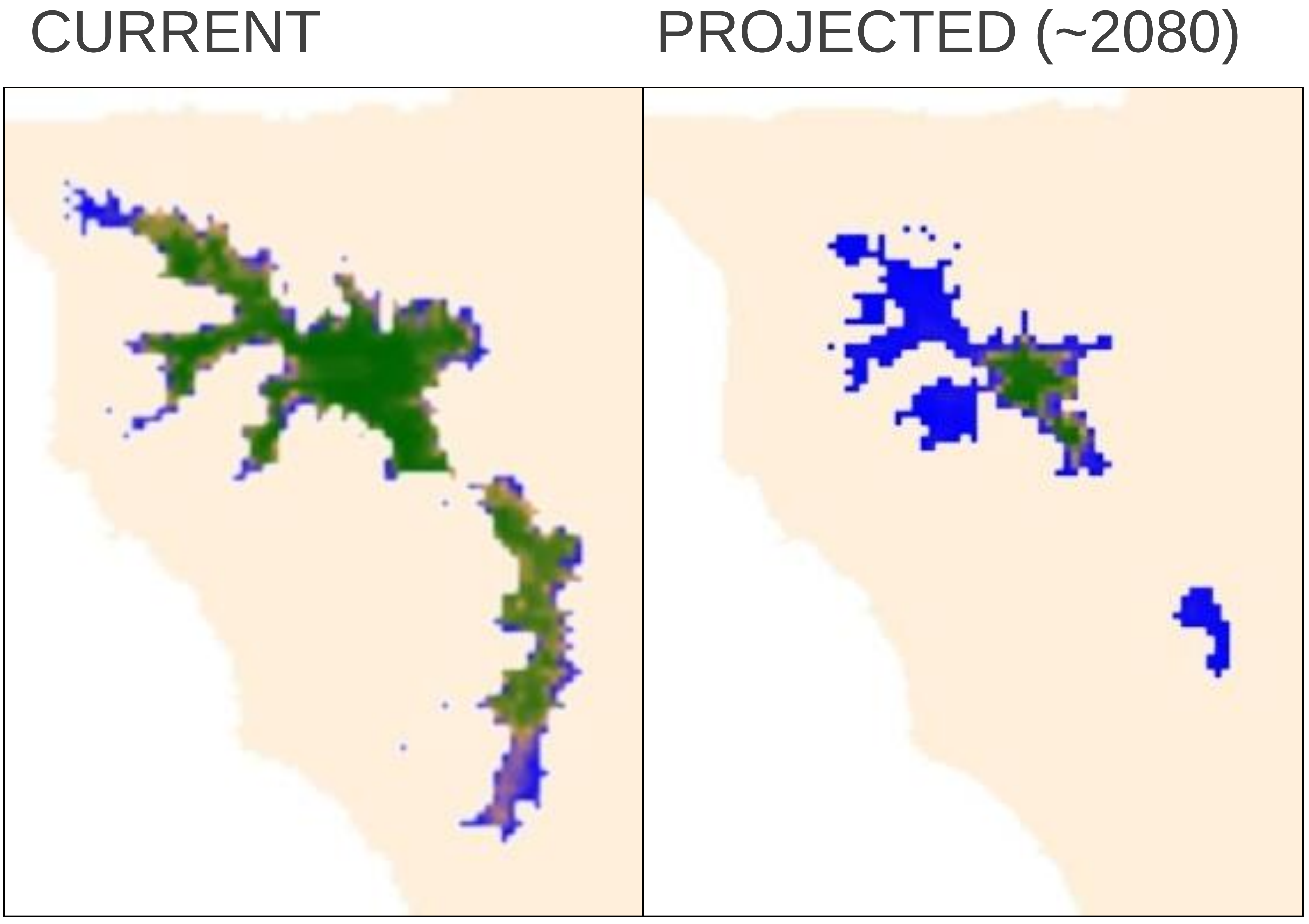
Modeling Results: Existing Range



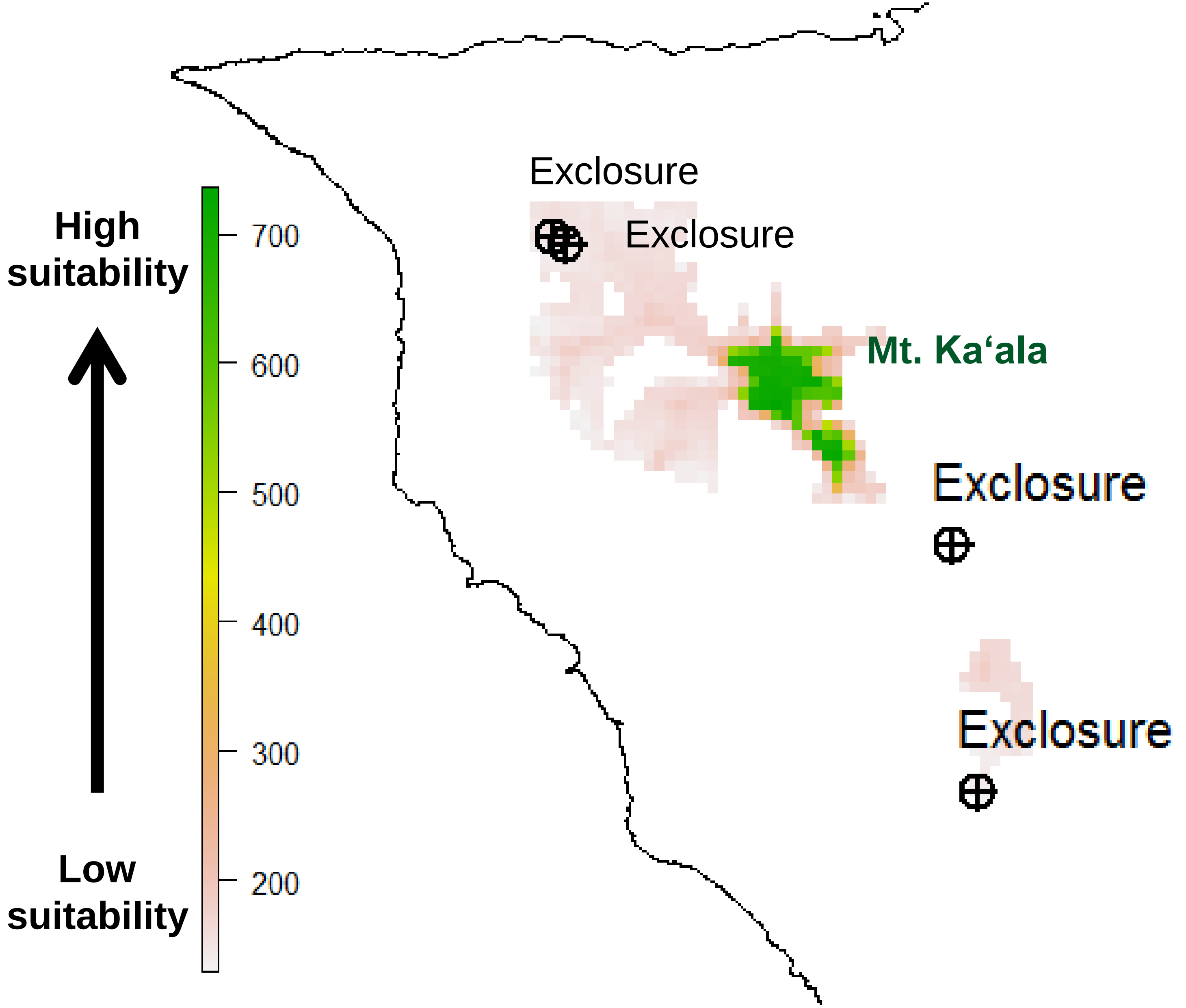
Projections based on…

- an A2B scaled-down scenario (Hamilton lab at UH)
- relatively optimistic
- projected to ~2080-2100

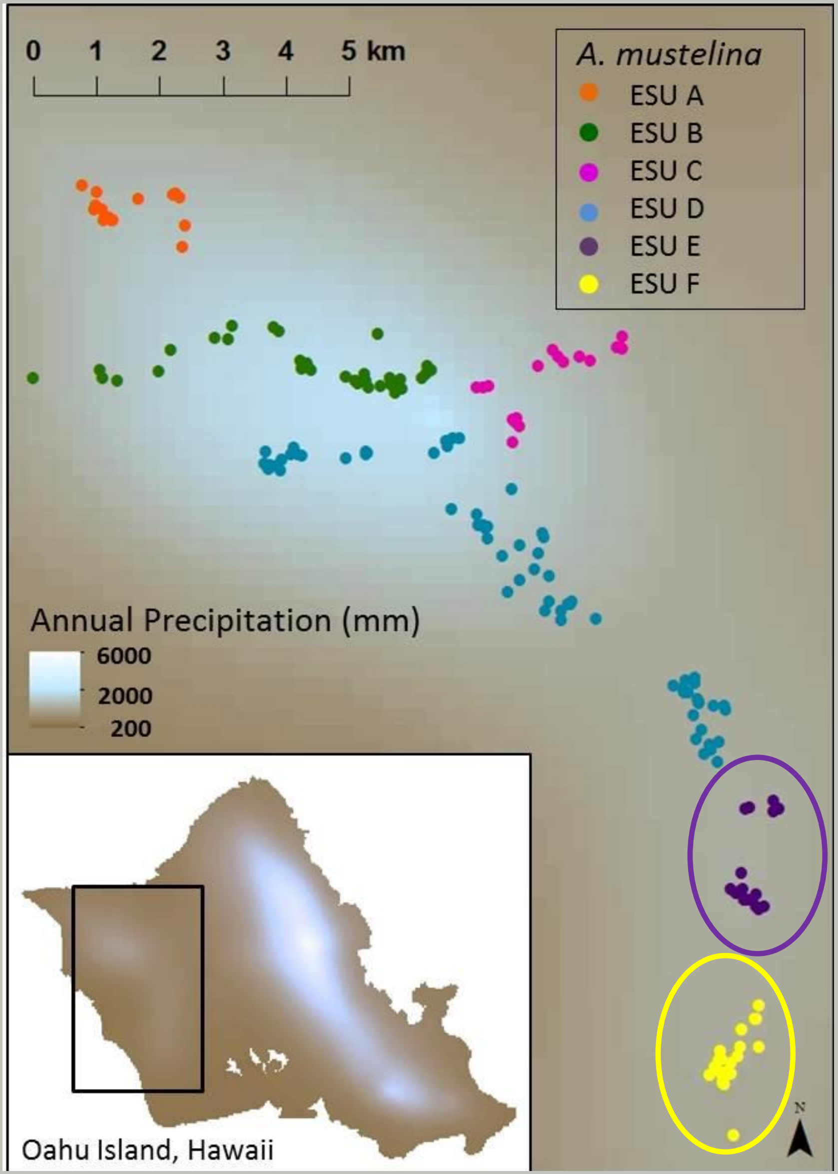
GIS Modeling Collaborator: Adam Vorsino, USFWS

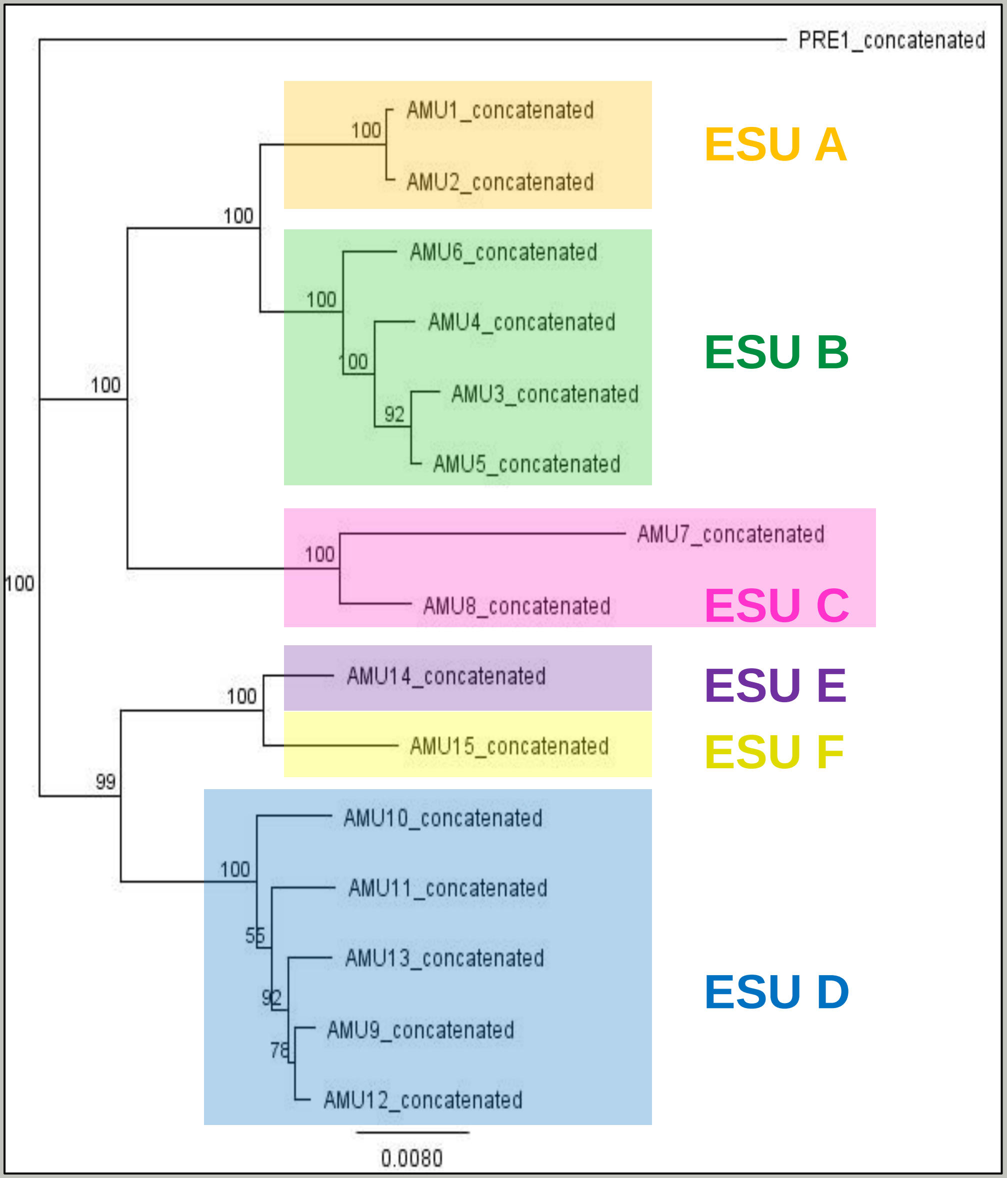

CURRENT
PROJECTED (~2080)

Result: Existing exclosures will be outside suitable areas



Result: Suitable areas will not preserve species diversity



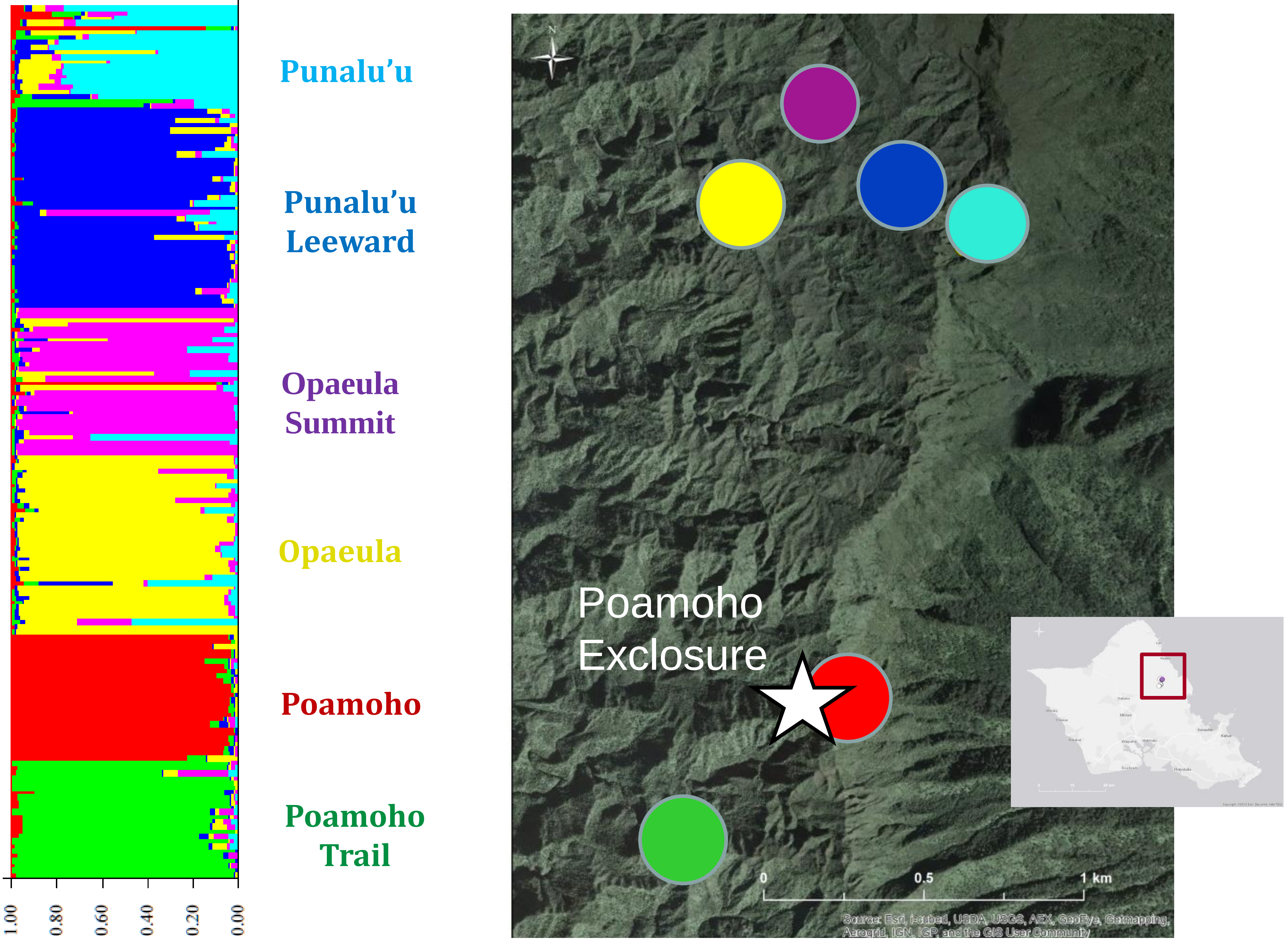


QUESTION 2:

Can we preserve species diversity, allowing for adaptation to warmer, drier climates?

Genetic Rescue?

(increase genetic diversity in inbred populations)

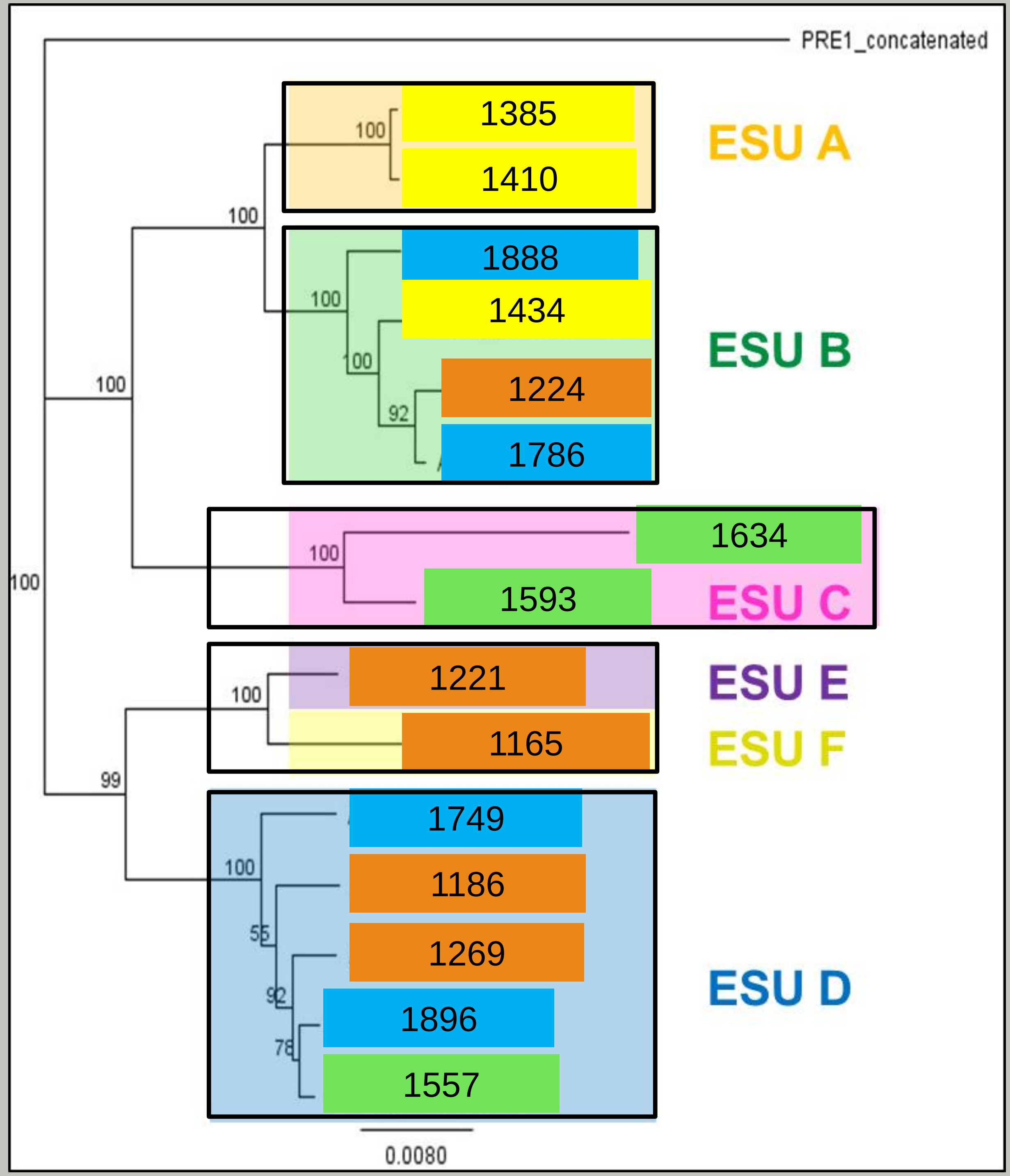

Punalu’u
Punalu’u Leeward
Opaeula Summit
Opaeula
Poamoho
Poamoho Trail
1.00
0.80
0.60
0.40
0.20
0.00
N
Poamoho Exclosure
0
0.5
1 km
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Assisted Evolution?

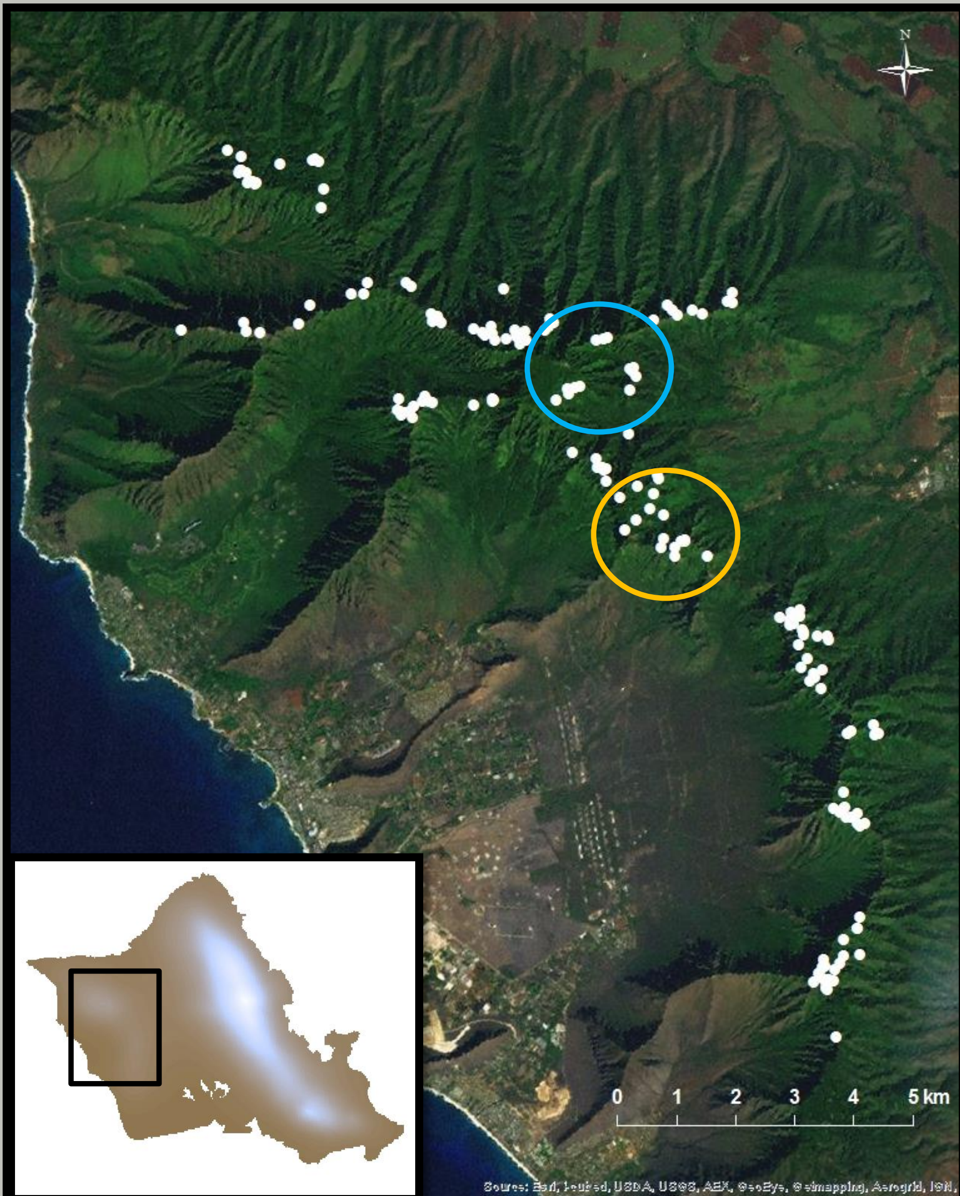
(a.k.a. Give natural selection something to work with, in a targeted way)

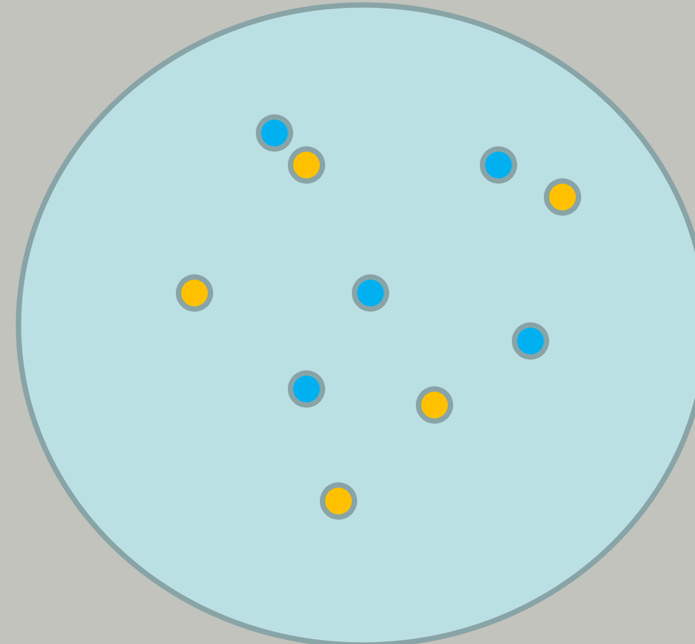
Precipitation varies among populations within ESUs

Genetic rescue may increase adaptive ability



Hawaiian tree snail distribution
(Achatinella mustelina)





Management Goals

Manage for **resilience**

- Restore forest biodiversity and ecosystem function
  - Removal of invasive species
  - Outplanting of native plants
  - Translocate animals
- Protect critical species interactions
- Maintain rare ecosystems
- Sustain/increase genetic diversity
  - Assisted evolution/natural selection
  - Genetic rescue